International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Neurological Manifestations of Heatstroke Population

Anees A. Sindi, MBChB

Department of Anesthesia and Critical Care, King Abdulaziz University Hospital, King Abdulaziz University, Jeddah, Saudi Arabia

Abstract: ***Objective:*** *To describe the neurological manifestations and neuroimaging of heatstroke patients.* ***Materials and Methods:*** *We extracted data retrospectively from patients' files and described their neurological manifestations and radiological features. An experienced brain-imaging radiologist reviewed and analyzed patients' radiographs to report on signs of abnormality.* ***Results:*** *This group included fifteen patients; eight males (53%) and seven females (47%), with an average age of (51.2 ± 10.1) years. Seven patients underwent brain imaging (CT scan), yet abnormal findings were detected in one patient images only. On the initial CT it showed bilateral thalamic and brainstem diffuse hypo-densities. The follow-up CT scans showed acute hemorrhage in the pons and 4th ventricle. There was third intra-ventricular extension of blood, with mild hydrocephalus.* ***Conclusion:*** *The study presented non-specific neurological findings that were associated with heatstroke patients. These findings may affect management and potential complicationsprognosis.*

Keywords: Heatstroke, CNS, Brain CT, Makkah

1. Introduction

Heatstroke is a serious medical emergency that could be fatal if not managed promptly [(1)]. It is caused by a significant rise in the human body's core temperatures, either due to an increasedproduction of internal heat following heavy exercise and exertion i.e. "exertional heatstroke", or due to prolonged exposure to high external temperatures and humidity "classical heatstroke" [(1-3)]. As a response to similar elevations in core temperature, the bodyinitiates a series of thermoregulation mechanisms and the failure of the latter can result in this condition and a potential multi-organ dysfunction. Central Nervous System disorders are the most common manifestations related to heatstroke, but other serious complications were reported including:"acute respiratory distress syndrome (ARDS), disseminated intravascular coagulation (DIC), shock, and renal failure". [(3,4)]

This disorder is relatively common in countries experiencing high temperatures during summer months. In fact, many countries reported an increase in the heat-illnesses related deaths after witnessing extreme heat waves. [(5)] Anestimated 50,000 deaths across Europe were reported and directly related to the heat wave in 2003. [(6)]Yet, and as a result of its varying clinical definitions, under diagnosis and lack of reporting, the global incidence of heatstroke remainsinconclusive. [(3)]

Every year, around two-million pilgrims from all over the globe visit Makkah in Saudi Arabia to perform the Islamic rituals of Hajj, and when the later coincides with the summer season, external temperatures can reachto degrees higher than45°C. This combined with a lack of adaptability to heat, strenuous physical rituals, and the vast exposed spaces with limited shade, makes heat exhaustion and heat stroke the two major causes of morbidity and mortality among pilgrims. [(7,8)]In this study, we will describe the neurological manifestationsand neuroimaging ofheatstroke patients who were referred to King Abdulaziz University Hospital (KAUH) during the Hajj season in September 2015.

2. Materials & Methods

The cases described in this study were fifteen pilgrims residing temporarily in Makkah, and who presented with a diagnosis of heatstroke to our hospital in September 2015. They were referred for treatment and further management in KAUH.

We conducted a retrospective review for the neurological and radiographic data of these patients,and prepareda descriptive chart recording the following parameters: age, gender, neurological manifestations; both at presentation and in response to treatment, radiological findings, and the final outcome. Patients' data were imported into a data collection sheet from the hospital's electronic database. Neurological manifestations and namely "follow up of response to treatment" were described using Glasgow Coma Scale (GCS) scores. It was reported for the entire period of hospital stay for each patient, and per availability in the hospital's records. For radiological examination, Computed Tomography (CT) of the brain was the test of choice, and all CT examinations were performed according to standard protocols i.e. using dual-source 128-detector row Somatom Definition Flash scanner. An experienced brain-imaging radiologist reviewed and analyzed the patients' radiographsto report on signs of abnormality.

All patients' personal information obtained during the study was kept confidential. Data was coded, then sorted and entered. Analysis was conducted using Microsoft office EXCEL (2010).

3. Results

There were eight males (53%) and seven females (47%), with an average age of (51.2±10.1) years. In terms of final outcomes only two (13%) patients died, while the majority of patients recovered completely and were discharged with no CNS residual complications. During their hospital stay, the GCSscores for all patients were recorded daily, and that continued until GSC was restored back to normal or patient's death. Out of the surviving thirteen patients

(86.7%), nine (69.2% out of 13 and 60% of total) were treated and discharged within or at the end of the first week (day 7). Two patients showed delayed improvement in the second week, and one patient was kept in the hospital for a longer period for management of other conditions, although she showed early GCS improvement in the first week.**(Table 1)** illustrates each patients scores on admission (Day 1), day (2), day (7), day (14) and almost one month later; on day (28).

Only Seven patients (46.7%) underwent brain CT scanning. An initial CT was performed on the same day of admission (Day 1) on four patients and one day after (Day 2)for the remaining three. Only three patients had more than one CT done. Two patients had a single follow-up CT scans, one had it four days after the initial examination and the other had it six days later. The third patient had two follow-up CT examinations at Day 15 and Day 33.

All initial and follow-up CT examinations were normal, except for one patient. The abnormal case showed on the initial CT findings of bilateral thalamic and brainstem diffuse hypo-densities**(Figure 1).**Both the day one (initial scan), and the follow up scan done on dayfour, showed acute hemorrhage in the pons and 4th ventricle. There was third intra-ventricular extension of blood, with mild hydrocephalus. Additionally, there was diffuse sulcal effacement and cisternal effacement, denoting increased intracranial pressure **(Figure 2,3).**

4. Discussion

The good prognosis for heatstroke patients is much related to the early diagnosis and management of its manifestations. [(9)]Taking a deeper look to the GSC scores, most patients showed remarkable improvement within the first week, with only few patients classified as critically ill when first admitted to our care in the Intensive Care Unit (ICU), and although most patients' initial management at Hajj facilities was unknown. In fact, apart from two patients, all of them were discharged from ICU with none of the potentialheatstroke complications reported before. This could be the result of rapid and efficient case evaluation and management undertaken for these patients as reported previously in similar cases, [(2), (9)] both when first appreciating the symptoms at Hajj locations, and when first presented to ICU. Yet, GSC scores were variable to suggest any relevant associations.

Radiological findings on the other hand, were non-specific, with normal neuroimaging reported on arrival for all patients except one patient. The latter showed"bilateral thalamic and brainstem diffuse hypo-densities", coinciding with symmetric lesions usuallyseen in heatstroke patients, [(10)] but follow up scans revealed "acute hemorrhage in the pons and 4th ventricle, and there was third intra-ventricular extension of blood, with mild hydrocephalus", all of which aresigns that could be caused by other underlying conditions, and not directly related to heatstroke pathology. This could have been accounted for with comprehensive initial assessment conducted at Hajj facilities, and its results shared with the referral point at KAUH. The latter could exclude other potential causes of neurological manifestations, and direct both patient management and case prognosis.

It must be acknowledged that the small number of patients described here, with the lack of accessibility to initial assessment or management undertaken at HAJ facilities limitsgeneralizing the conclusions to larger populations. Yet, we hope that thiswork can highlight the need for thorough initialheatstroke assessments, both at primary presentation andwhen arriving at secondary referral point, with a special emphasis on appropriate and meticulous neuroimaging.

5. Conclusion

In this group of patients, GCS scores were variable and most neuroimagingwerefound normal. This highlighted the non-specificity of neurological findings often associated with heatstroke patients, making potential complication prognosis and management rather challenging. More studies are needed to track similar patients, and define heatstroke neurological prognosis.

References

[1] Y. Epstein1, W. O. Roberts. The pathophysiology of heat stroke: an integrative view of the final common pathway.Scand J Med SciSports 2011; 21:742–748.
[2] B. Yaqub, S. Al-Deeb. Heat strokes: aetiopathogenesis, neurological characteristics, treatment and outcome. Journal of Neurological Sciences 1998;156: 144–151.
[3] G M Varghese, G John, K Thomas, O C Abraham, D Mathai. Predictors of multi-organ dysfunction in heatstroke.Emerg Med J 2005;22:185–187.
[4] Theresa Pluth Yeo. Heatstroke: A comprehensive review. AACN Clinical Issues 2004; 15: 280-293.
[5] T. Morimoto, S.Nakai and T. Itoh.Global Warming and Deaths from Heat Stroke, In:M. Kosaka et al. Thermotherapy for Neoplasia, Inflammation, and Pain 1st edn. New York Springer Japan; 2001. p107-110.
[6] G. Brücker.Vulnerable Populations: lessons learnt from the summer 2003 heat waves in Europe.Euro-surveillance, European Communicable Diseases Journal 2005; 10:147.
[7] Q. A. Ahmed, Y. M. Arabi, Z. A. Memish.Health risks at the Hajj. Lancet 2006; 367: 1008–15.
[8] Z. A. Memish. The Hajj: communicable and non-communicable health hazards and current guidance for pilgrims.Euro-surveillance 2010; 15:39.
[9] R. Singh-Jain,S. Kumar,R.Agarwal andP. Kumar-Gupta. Acute Vertebrobasilar Territory Infarcts due to Heat Stroke. Journal of Stroke and Cerebrovascular Diseases2015; 24: 135–138.
[10] J. Li, X. Zhang, Z. Zou, B. Wang, J. Xia, Heat stroke: typical MRI and 1H-MRS features. Clinical Imaging 2015; 39: 504–505.

Table 1: Clinical picture of 15 heatstroke patients during their hospital stay

Patient Index	*AGE*	*Gender*	*Glasgow Coma Scale Scores*					*Critically Ill*	*Outcome*
			Day 1	*Day 2*	*Day 7*	*Day 14*	*Day 28*		
1.	61	Female	15	15	-	-	-	No	Discharged on day (6)
2.	49	Female	15	15	-	-	-	No	Discharged on day (4)
3.	69	Male	6	13	-	-	-	No	Discharged on day (6)
4.	45	Female	8	-	-	-	-	No	Discharged on day (4)
5.	55	Female	-	-	-	-	-	No	Discharged on day (4)
6.	42	Male	5	9	-	-	-	Yes	Discharged on day (3)
7.	30	Male	9	10	-	-	-	Yes	Discharged on day (6)
8.	59	Male	12	14	14	-	-	No	Died on day (16)
9.	56	Female	8	14	-	-	-	Yes	Discharged on day (3)
10.	55	Female	7	8	15	14	-	Yes	Discharged on day (21)
11.	44	Male	3	3	3	-	-	Yes	Died on day (12)
12.	65	Male	3	15	14	-	-	Yes	Discharged on day (7)
13.	44	Female	5	9	14	13	9	No	Discharged on day (42)
14.	40	Male	8	9	7	3	14	Yes	Discharged on day (20)
15.	54	Male	8	10	15	-	-	Yes	Discharged on day (83)

Figure 1: Initial CT showing evidence thalamic hypodensities.

Figure 2: Follow up CT showing evolution of hemorrhage

Figure 3: Initial CT showing evidence of posterior fossa hemorrhage